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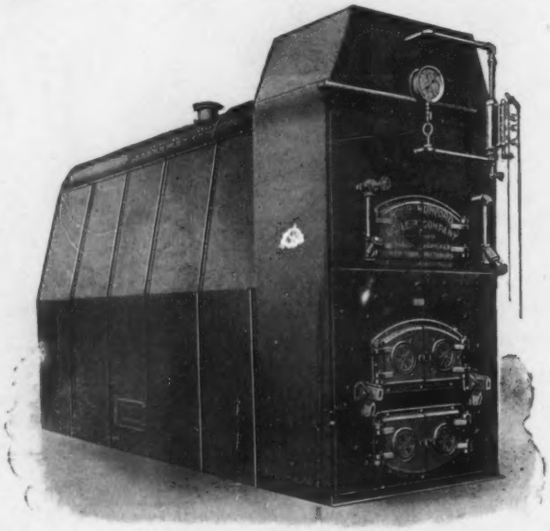

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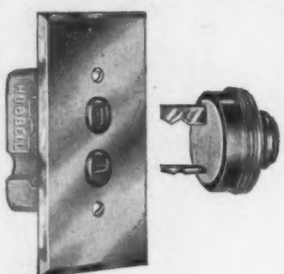

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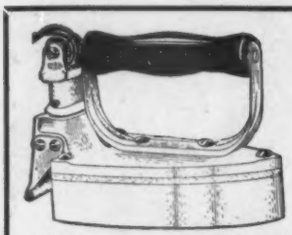

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SOME SUGGESTIONS IN DAM DESIGN

By Lars Jorgensen *

So far it has been considered standard practice to design a concrete or masonry dam in such a way that the lines of pressure, reservoir empty, and reservoir full, fell within the middle third of the section. By figuring sections of several dams, it occurred to the writer that this theory does not necessarily give the best profile.

A Mountain Reservoir

Figure 1a and 1b shows a profile of a cyclopean concrete dam calculated from the usual formulae given in Mr. E. Wegmann's excellent book, "Design and Construction of Dams," and other books and checked graphically. In connection with these formulae, Prof. Rankine's values for the limiting pressures along the down and up stream face are used. They are about 16,000 lbs. per square ft., or 111 lbs. per square inch for the down stream face, and 20,000 lbs. per square ft., or 139 lbs. per square inch for the up stream face. These pressures were decided upon thirty years ago. Today the ultimate compressive strength of concrete, 1:3½:8, is about 2,000 lbs. per square inch six months old. It would, therefore, seem perfectly safe to use values at least twice as high as was customary thirty years ago. In all other construction work compressive stresses three times as high are considered safe for concrete, and for a dam with its large mass of concrete, it certainly seems safe to use a high compression at least twice the usual, on account of the lateral support of the central portion of the concrete.

A concrete dam is built on solid rock, or solid material,

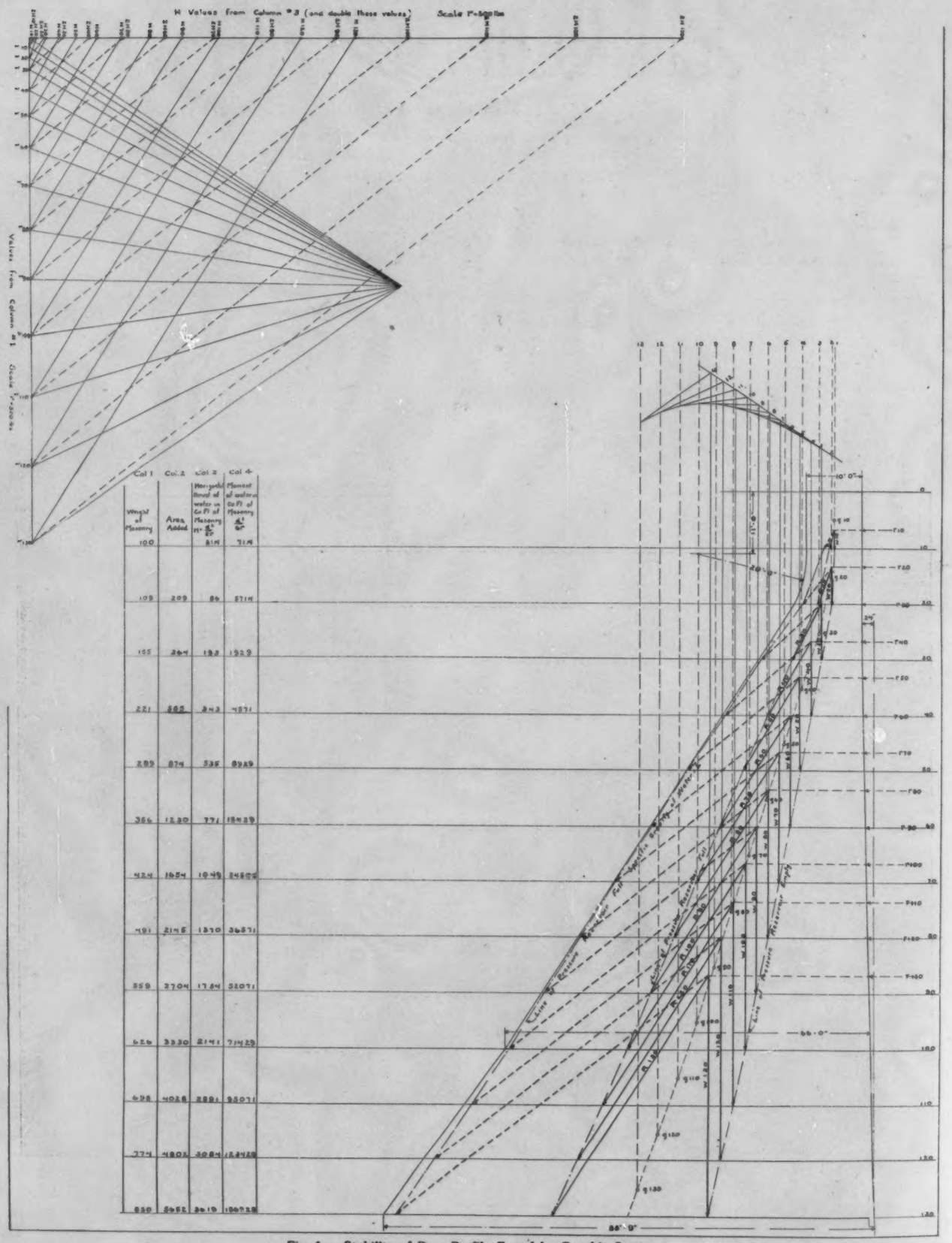

Fig. 1a. Stability of Dam Profile Found by Graphic Statics

The profile is divided into courses 10 ft. apart, and the centers of gravity of the different courses found in any usual way. The weight of each course is given in column No. 1 and the horizontal water pressure in column No. 3. From these values the force polygon is drawn and the resultant of the forces acting upon the dam found. The points of the line of pressures will be where these resultants intersect their respective joints. The diagram should be self-explanatory.

otherwise it has no place there. Solid rock is not elastic, but will safely support 60 tons per square foot, and possibly twice that, before the elastic limit is reached, or three times as much as the concrete. As the usual formulae are derived under the assumption that the foundation is elastic, they give too safe results for the up stream face. The pressure along this face is found from the formula $p=\frac{2W}{l}\left(2-\frac{3u}{l}\right)$ (See Fig. 2 for explanation.)

Formulae 1, 2, 3, 4, 5 are taken from Mr. Wegmann's book, pages 14, 21, 22 and 23, fifth edition, where full explanation can be found.

If, however, $u < \frac{l}{3}$, we should have tension in the down stream toe according to the theory of uniformly varying stress on which the formula is based. As the foundation is by no means elastic, no such thing as tension from this cause in the toe seems possible.

and not when the reservoir is empty. With a perfectly vertical face 276 feet high the factor of safety with the reservoir empty would be $\frac{2000}{278} = 7.2$. For practical reasons it might be desirable to slope the face slightly, for instance, 1 ft. in 50 ft., to insure the facing (stone facing or a sheet of watertight concrete) to lie on the main dam body by means of gravity. This facing should be watertight to prevent water from seeping into the mass of the dam, exerting an upward pressure, tending to overturn the dam. About the only way to make and to keep the face watertight would be to have a layer of watertight concrete on the up stream face. This sheet should not be attached solidly to the main body of the dam, but should be separated by means of a layer of broken stone about 1 inch thick and be anchored to the main body of the dam only often enough to prevent its falling off when the reservoir is empty.

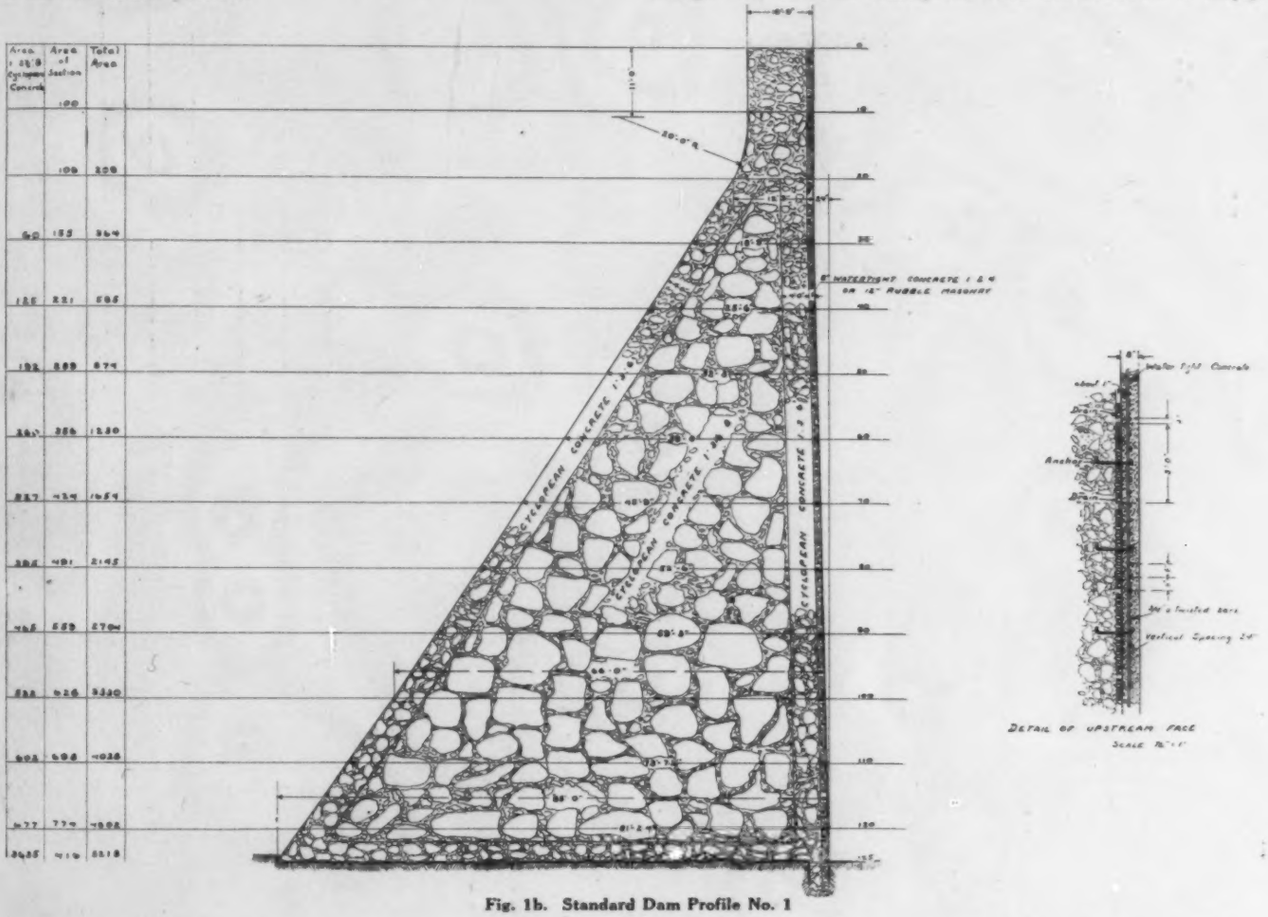

Fig. 1b. Standard Dam Profile No. 1

When calculating a dam we have always been accustomed to divide the profile into horizontal sections. Let us divide it into vertical sections for a change. (See Fig. 3.) With reservoir empty, the maximum pressure on the foundation for column A is the weight of this column. The safe height H is found from $145.H = 40{,}000$; $H = \frac{40{,}000}{145} = 276$ ft.

The weight of one cubic ft. of the concrete is taken as 145 lbs., and the allowable pressure per square ft. = 40,000, or 278 lbs. per square inch. The unit pressure on the foundation, due to the weight of B and C, will be less, so we need only consider the weight of A, and it is inconceivable how this weight could produce tension in H and I.

The up stream face can be made vertical to a height of 276 feet. The material saved in this way could be placed on the down stream face, thereby increasing the stability with reservoir full of water; that is the time we need a safe dam

A sheet of watertight concrete 8 inches thick can cheaply be reinforced sufficiently to prevent temperature cracks, providing this facing is not forced to take part in the expansions of the main body. The seepage through the sheet should be drained off to prevent accumulation of enough water to cause any considerable pressure back of facing with reservoir full. The pipes carrying this drainage water from the up stream face out through the toe could be of wrought iron, provided with valves, and these valves could be kept closed with reservoir less than three-fourths full to save water in case the leakage should be considerable. For detail see Fig. 1b. For such construction, the cost of reinforcing steel would be $29 per running foot for a dam 120 ft. high, with steel at 5 cents per lb. in place.

Having decided upon a vertical face to a height of 276 ft., or 1:50 slope, the calculation of the dam for reservoir full becomes very simple. Three or four formulae are all that are

necessary. The top width is taken 10 ft., and the distance both faces may remain vertical is found from

$$d = a\sqrt{\quad} \qquad (2)$$

where a = top width, r = specific gravity of material = $2\frac{1}{3}$

$$d = 10\sqrt{2\frac{1}{3}} = 15.3 \text{ ft.}$$

Below this point the down stream face is sloped to keep the line of pressure reservoir full within the center third of the profile.

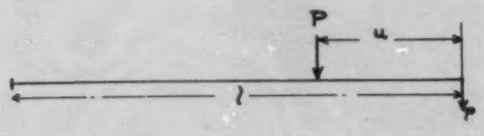

Fig. 2

P = weight of Masonry on top of joint.
l = length of joint.
p = unit pressure along upstream face.
u = distance from upstream face to P

The length X of any horizontal section at 30' depth ($d = 30$) is found

$$X^2 + \left(\frac{4w}{h} + l\right) X = \frac{6(wm + M)}{h} + l^2 \qquad (3)$$

See Figures 1 and 4 for values $M = \frac{d^3}{6r} = \frac{30^3}{6 \times 2\frac{1}{3}} = 1929$

$$X^2 + \left(\frac{4.153}{14.7} + 10\right) X = \frac{6}{14.7} (153 \times 5 + 1929) + 100$$

$$X^2 + 51.6\,X - 1200 = 0$$

$$X = 17.4 \text{ ft.}$$

$$v = \frac{M}{W} = \frac{1929}{346} = 5.57 \qquad (4)$$

The thickness of the dam at any lower point may be found as above, and, as the batter of the front face has been decided already to a depth of 276 ft., the position of the joints is also determined down to this depth, doing away with much calcula-

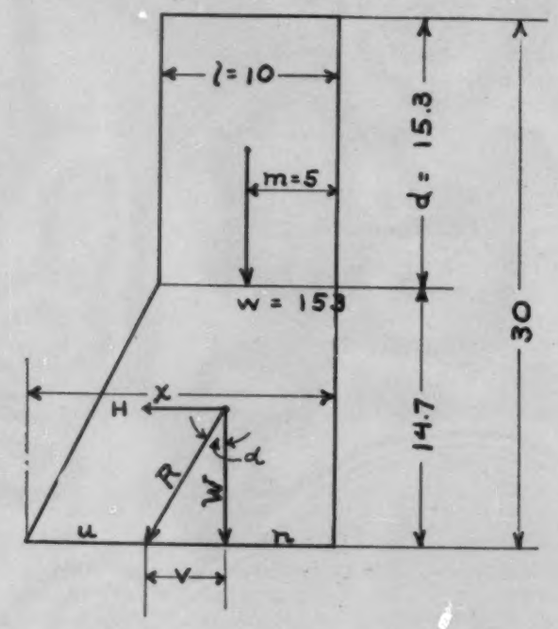

Fig. 4

tion. As long as the center line of pressure reservoir full is in the middle third of the profile, then u > v and the factor of safety against overturning is at least 2. With a liquid of twice the specific gravity, M in the formula $\frac{M}{W} = v$ would be doubled, thereby doubling v. The center line of pressure reservoir full, would now lie only a little inside the down stream face. During the travel of the center line of pressure between the middle third and the outside position, tension in the up stream face will commence; just when is difficult, perhaps impossible, to calculate. Maybe the compression can be distributed over a large enough area to keep the unit stress well below the elastic limit, in which case we would have no tension in the up stream face before the line of pressure fell outside the section.

To resist the horizontal thrust of the water we have the shearing strength of concrete and the friction.

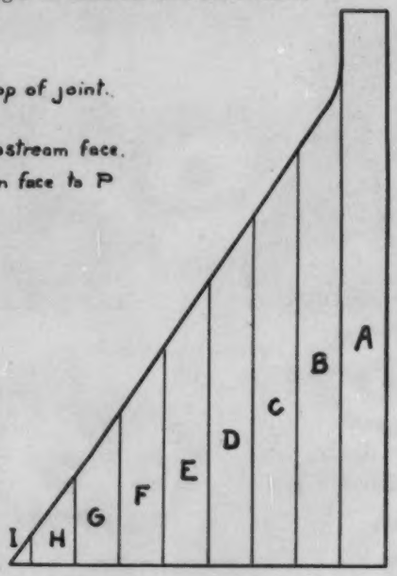

Fig. 3

The friction coefficient is

$f = \frac{H}{W} = tanga$, where a is taken 36° maximum; in other words,

$$\frac{H}{W} = 3/4.$$

The shearing strength of the concrete is generally neglected, the reason given being that it is an uncertain quantity. So is also the friction, and as the resistance the gravity section would offer against shear even at a very moderate stress is much larger than the resistance it would offer against sliding, if only the friction is taken into consideration, the writer sees no reason why it should be neglected.

For instance, take the thickness of the dam 30 feet from the top, 17.4 feet as found above, and the width 1 foot. The horizontal thrust of the water would be $\frac{pd}{2r} = 193 \times 145 = 28{,}000$ pounds. This would cause shear distributed over an area of 17.4 square feet, or $17.4 \times 144 = 2505$ square inches.

Unit shearing stress $= \frac{28000}{2505} = 11.2$ pounds per square inch.

The factor of safety would be between 10 and 20.

The friction coefficient $f = \frac{H}{W} = \frac{193 \times 145}{346 \times 145} = 0.558.$

Factor of safety for friction $\frac{0.75}{0.558} = 134$†.

The safe unit stress on the down-stream face was taken as 32,000 pounds per square foot, and when this is reached the length of the lower joints is found from

$$X = \frac{6M}{p} \text{ where } p = 32{,}000 \qquad (5)$$

So far the factor of safety of the dam against overturning has been found to be two or slightly more reservoir full. By introducing steel rods in the up-stream face and in the toe, this factor of safety can with but little extra cost be brought up to 4, the usual minimum generally employed in all other construction work.

(†Values for H and W taken from Figure 1.)

Taking a dam 120 feet high, the total horizontal water pressure per running foot length is $3084 \times 145 = 447,180$ pounds. (From column 3, Fig. 1.)

The moment of this pressure around any point in the foundation at 120 feet

$$447,180 \times 40 = 17,897,200 \text{ foot-pounds.}$$

Rubble Masonry Dam.

The resisting moment of the section (see Figure 5) is As. fs. g^1 where As is the area of steel, fs the unit tensile stress in the steel and g^1 the moment arm of the couple. In this case with sufficient accuracy $g^1 = 0.85g = 0.85 \times 75 = 63.8$ ft.

The ultimate tensile strength of twisted steel is above 80,000 pounds per square inch, and the elastic limit is at about 55,000 pounds per square inch. The factor of safety need be only two. Therefore, fs can be taken at 40,000 pounds per square inch. At this high tension the concrete will help out the steel some.

Then, moment of water $= As \times 40,000 \times 63.8 = 17,897,200.$

$$As = \frac{17,897,200}{63.8 \quad 40,000} = 7 \text{ square inches}$$

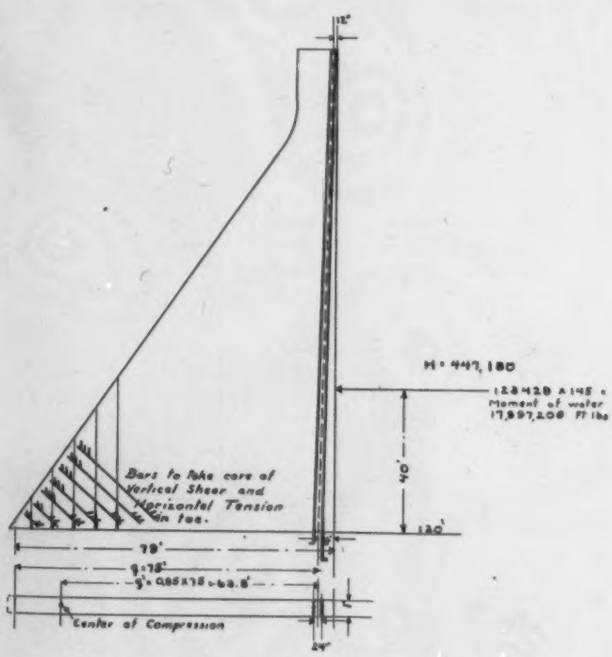

Fig. 5.

The section could be made up of 7-1 inch square rods and decreased towards the top corresponding to the decreasing load. For a dam reinforced in this way, floatation does not need to be considered, nor is the reinforced water-tight facing necessary. If steel is left out, the maximum tensile stress in the concrete will be

$$\frac{\text{Bending Moment} \times \text{Distance from neutral axis to outer tension fiber in concrete.}}{\text{Moment of Inertia.}}$$

$$\frac{17,897,200 \times 39.5}{\frac{1}{12} \times 79^3} = \frac{706,939,400}{41086} = 17,200 \text{ lbs. per square ft.} = 120 \text{ lbs. per square inch.}$$

With this unit tension, the factor of safety will be about 1½. This shows that a concrete dam without steel reinforcing well made will stand up even should the line of pressure reservoir full fall clear outside the profile. The compressive stress in the down-stream face due to the bending moment should be added to the compressive stress due to the resultant of the weight of the dam and the horizontal component of the water pressure. The factor of safety of these combined stresses would in all cases be more than 4.

One point which has not yet been considered is the vertical shear, and the horizontal tension in down-stream toe caused by the bending moment of the horizontal pressure of the water. These forces evidently are in existence, although they may not amount to much. How to make correct assumptions for their calculations the writer does not know, but suggests to put some reinforcing steel at random in the toe to take care of these stresses. This steel would also add to the strength of the concrete mass along the toe where the compression is the highest and the same unit stress as is used for the up-stream face could be used for the down-stream face also.

The additional cost of reinforcing the dam as proposed will be about $05 per running foot for a 120-foot dam with twisted steel at 5 cents a pound in place. The contents per running foot of a dam 120 feet high with a profile as shown in Figure 1 is 178 yards. At $10 a yard in place, the cost is $1,780 per running foot. Percentage cost to be added for steel

$$\frac{95 \times 100}{1780} = 5.33\%$$

With 5.33% added to the cost, we add 100% to the strength. It may be argued that the steel may rust out in 100 years; but if the concrete is properly put in, at the end of 100 years it should have nearly as much additional strength in itself as the steel and concrete together when it was first put in.

COPPER MARKET SITUATION.

The market for copper has been quieter lately, but it is natural to expect a slowing down in buying activity as the year-end comes into close view. Consumption, however, and mill operations are progressing finely. Manufacturers note a most substantial increase in business within the past month and a half, and most of the prominent establishments are now running full time. The demand for manufactured products developed rapidly last month, and we are getting nearer to normal conditions than at any time this year, and a trade revival along all lines is what competent observers are building upon.

So far as the local copper market itself is concerned, business is less active than a few weeks ago. The diminution in the volume of sales is not so surprising after the heavy buying in November, when manufacturers provided themselves freely with the necessary copper to fill the major part of their orders for from thirty to sixty days. Although recent purchases have been moderate, sellers generally maintain a firm grip on the market. While some irregularity in prices has prevailed owing to offerings of spot and December copper, we find it difficult to quote January and February electrolytic wirebars under 14½. In fact, it might be a hard matter to buy for the next two to three months much below 14½ in this market, although foreign buyers could probably do better than buyers here.

PRESSURE FLUCTUATIONS IN TURBINE PIPE LINES.*

By Prof. A. Budau, Engineer, Vienna, Austria.

The progress in utilization of water power frequently compels the engineer to transfer his work from the inhabited valleys to rough mountain regions where, of the two factors of hydraulic energy, viz., head and quantity of water, at least the former is available in abundance.

The utilization of water power with high head, however, offers some difficulties. To obtain a high head, most frequently a long ditch is required whose construction is made difficult by unfavorable topographical conditions and obstructions to transportation. Next to this, in most cases, comes a very long pipe line which forms a very disagreeable link in the complicated mechanism of a hydraulic power plant, because it not only means an increase of first cost of the plant, but also causes complications of operation.

Against freezing of the pipe, covering of same is only a scant protection. During the time of severe cold weather, water has to run through the pipes continuously; otherwise they will freeze, notwithstanding the covering; but even during the warm seasons a pipe line can cause difficulties if, as is always the case in these days, a very accurate speed regulation of the turbines is required.

The modern turbine governors open and close very rapidly. Ten years ago governors were not an exception which, in case of complete drop of load, happening, for instance, as a result of a short circuit in the electric net, shut the turbine off in twelve to thirteen seconds; but the time of closing has been continuously reduced, especially since the so-called hydraulic governors have been adopted, which have stored energy available, and today, a closing time of two seconds for turbines of many thousands of horsepower cannot yet be taken as the lowest limit.

It is impossible to rapidly stop the flow of a large quantity of water offhand, and certain precautions have to be taken. It goes without saying that these precautions have to be most careful and most complete if the water is conveyed to the turbine in a long pipe line.

The discussion of such devices, and some theoretical investigations referring to same which a practicing engineer, on account of the absence of any guiding material in literature, must carry out to satisfy the responsibility thrust upon him; further, some experiences with long pipe lines, will constitute the contents of this paper.

If a certain quantity of water Q flows through a pipe line of the cross section F, the water in this latter will obtain a certain velocity v which can be calculated from the formula $v=Q:F$, if the quantity Q of water is known which flows through the pipe in a second. If the water is conveyed through the pipe line to a turbine, and H is the head from the head water level to the distributer of the turbine, immediately in front of the turbine a water pressure will prevail which is equal to $H-\frac{v^2}{2g}-\frac{\xi v^2}{2g}$, wherein ξ represents the coefficient of the pipe friction and g the acceleration of gravity. If now, while the water is flowing, its discharge from the distributor is suddenly stopped, a great rise of pressure will take place, especially at the lower end of the pipe line, and unless the pipes are elastic, their rupture will necessarily follow.

The water flowing in the pipe with the velocity v contains the energy A which cannot suddenly be destroyed and must necessarily express itself in deformations of the pipes. This energy, if L represents the length of the pipe line and F its cross section, expresses itself:

$$A=\frac{F\times L\times\gamma}{g}\cdot\frac{v^2}{2} \qquad \text{I}$$

wherein γ represents the specific gravity of the water.

* Translated from the German and partly read by Heinrich Homberger, before the Technical Society of the Pacific Coast. Reprinted from Journal of the Association of Engineering Societies.

This rise of pressure, which, if occurring with considerable force, is feared in water mains as so-called hammer, one has endeavored to reduce in turbine pipe lines by installing at the lower end of the pipe line an air chamber (Fig. 4) or a standpipe B, also called free air pipe (Fig. 5), whereby the energy of the water flowing in the pipe line was to be given an outlet, compressing the air in the air chamber or lifting the water in the standpipe. Also safety valves have been applied.

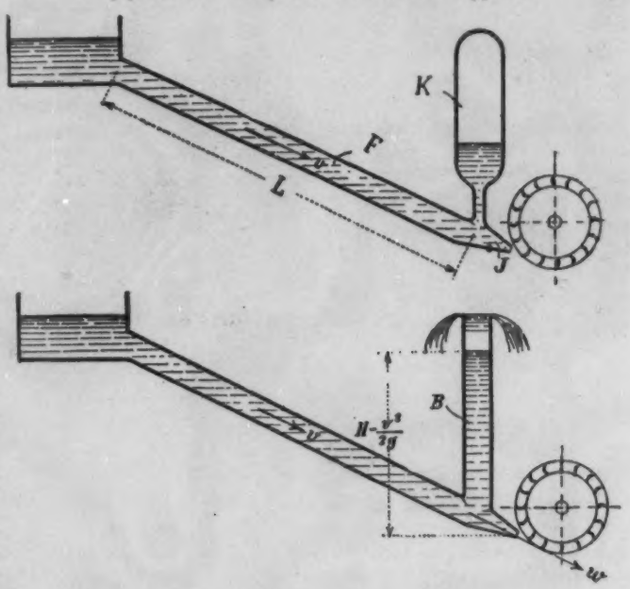

Fig. 4 and 5

There are, however, and especially in the most modern plants, by-passes or synchronous gates, devices which are operated simultaneously with the gate mechanism of the turbine so as to give to the water, which is held back when the turbine distributer is closed, an outlet into the tail water.

The writer advised such arrangements twelve years ago in a paper published in 1893 in the *Schweizerische Bauzeitung*. In the meantime, also, machines have been built where the non-utilized water passes through the distributer of the turbine, and such turbines, with combined distributer and free passage regulation, are designated as free passage turbines.

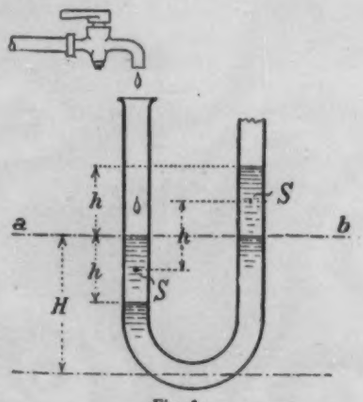

Fig. 1

Standpipes are used under heads up to 100 feet, and economically only then if the topographical conditions are otherwise favorable. Air chambers have been frequently installed in former years; nowadays, however, they are not used any longer. Under the high pressure the water absorbs the air which is above it, and continuous refilling with air by means of specially provided compressors was found necessary, which soon became cumbersome to the operators. One also hears, in some cases, that the governors operate better if the air chamber does not contain any air at all and is a water chamber only;

and that the shocks of the water are not so bad as to cause any damage to the pipe, etc.

This, indeed, is logically correct, and it can be easily proved that air chambers themselves can become the cause of increasing periodical oscillations of the speed governors.

In a U-shaped bent tube (Fig. 1), let water be up to height H, which, of course, is equal in both legs. By some cause the water is brought into oscillation, and it will rise above the line ab in either leg alternatively, and fall below H. These oscillations of the water level in the two legs of the tube will last quite awhile; in fact, they would not stop at all if there was no friction at the walls of the tube and between the particles of water themselves. The elevation of the center of gravity S of the water cylinder of the cross section F and the length h, or, in other words, the length h multiplied by the weight of the water cylinder, $F \times h \times \gamma$, gives the amount of energy which is contained in these oscillations and which also had to be contributed to the water to bring it into oscillation.

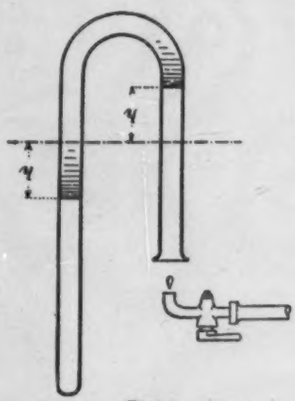

Fig. 2.

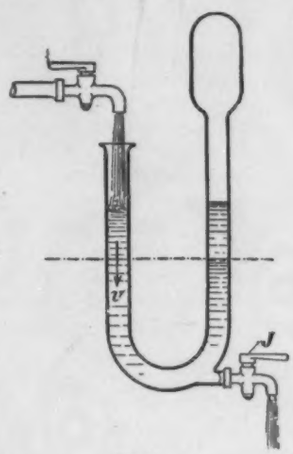

Fig. 3.

If now, while the water level is going down, a drop of water is allowed to fall into it, the height of oscillation h will be increased a small amount, and if frequently at the correct moment a drop falls upon the oscillating fluid, the oscillations of the water will increase until an overflow of water over the edge of the tube takes place.

The same will occur if one of the two legs of the tube is closed on top or if an air cushion is located above one of the water levels (Fig. 2), only in this case the oscillations h will be smaller and will only reach a certain maximum value, since the reaction upon the water level in the closed leg of the tube increases with increasing rise.

Also a moving water column can be brought into increasing oscillations by continuous small impulses if it is connected with an air chamber.

Through the left leg of the U-shaped tube (Fig. 3), water is supposed to flow with a velocity v, discharging through a cock J. If now this cock is suddenly closed, a rise of pressure takes place which will cause a compression of the volume of air in the right closed leg of the tube, and the fluid, the flow of which is stopped, will be brought into oscillation exactly as in the previous case. If the cock J is not entirely but only partially closed, this will also cause an impulse to oscillate. There will also be oscillations which will be smaller than if the cock had been closed entirely, but which will last until the impulses of the particles of fluid against each other, and especially against the ones newly entering in the left leg of the tube, and further, the friction of the water on the walls of the tube, have used up the respective amount of energy.

If, for instance, the cock is only half open and be closed a certain amount every time when the water in the right leg rises, and then opened again, the oscillations can be raised to a maximum amount, the analytical calculation of which is not simple; but it will occur if the cock is alternately entirely opened and entirely closed.

Considering a high-pressure turbine provided with air chamber and governor (Fig. 4), one can see immediately its analogy with the arrangement shown in Fig. 3. The regulating apparatus of the turbine has taken the place of the cock J in Fig. 3; the retardation of the flow in that moment at which the pressure rises, viz., when the water enters the air chamber K, is accomplished with the greatest accuracy by the speed governor. If, from any cause—for instance, on account of shutting of a by-pass in the pipe line—a rise of pressure occurs at its lower end, the governor of the turbine running under a constant load will be forced to somewhat reduce the amount of water entering the turbine; since the pressure rise, on account of the shutting, would have as a result an increased flow of water from the supply apparatus, therefore a larger amount of water supplied to the turbine; this would result in a speeding up of the turbine. The now following return wave will cause a drop in water pressure, the output of the turbine will be reduced, the governor will open and again close at the next pressure rise, and it can easily be seen that under these conditions the governor can increase the oscillations in the water column up to a certain maximum value.

Such experiences with air chambers have been had at many places, and it is surprising that so far nothing about them has gained publicity.

The above investigation also shows that the oscillations will decrease the quicker, the larger the amount of water flowing through the pipe line, because the newly entering water, on account of its inertia, will counteract the oscillations, and, therefore, is a very powerful factor in damping the water fluctuations.

This also explains the fact, which is very little known, that one can steady the governor which has become uneasy on account of water oscillations in the pipe line by opening a by-pass and giving the water in the pipe line a higher velocity. Experience also shows that simultaneous oscillations of the governor and of the water in the pipe line more readily happen when turbines utilize small quantities of water, viz., in cases where the velocity of the water in the pipe line is low.

In this respect standpipes, which have been frequently used in America, are better than air chambers. At a sudden complete or partial closing of the supply apparatus of the turbine (Fig. 5), the water level of the standpipe B will rise on account of the rise of pressure, and part of the water Q' will overflow the edge of the standpipe. The energy of oscillation, as a result, will be decreased in accordance with the ratio $\frac{Q'}{Q-Q'}$ if Q represents the quantity of water flowing in the entire pipe line. The return wave must, therefore, be necessarily much smaller since the water at each following forward wave loses some of its energy on account of the water overflowing the edge of the standpipe. This circumstance, and the damping action of the water newly entering the pipe line, which changes energy of oscillation into eddies and friction, just as with air chambers, brings the oscillations very quickly to a stand-still, even if the speed governor has the tendency to increase same.

Similar to the standpipes act the safety valves; they must however, be sufficiently large to discharge at each oscillation a sufficient amount of water to cause a decrease of the energy of oscillation, notwithstanding the disturbing influence of the governor.

Also pressure-regulating devices have been provided which, in case of an increased pressure of the water, open a by-pass to the tail water; as, for instance, spring balanced accumulators, where the plunger, in case of rise of pressure, moves upward and opens a by-pass. Such devices are better than air chambers because they take energy out of the water, and also better than standpipes, because they do not contain a great mass.

Any engineer who has to determine upon the dimensions of the pipe line is interested to know what increase in pressure will take place in the line if it is quickly closed, with a lower limit not to be exceeded, say two seconds, and if the water was flowing previously with maximum velocity corresponding to the turbines being totally open.

Increase of Pressure in a Pipe Line at Sudden Closing

An investigation as to what extent the pressure can rise in a pipe line if the latter is closed suddenly, so that the entire kinetic energy of the water flowing in the line has to be taken up by the elasticity of the pipe walls (used for doing work of deformation), gives a definite formula.

$$(h_0)=\sqrt{h_1^2+\frac{3S}{D}\,\frac{Ev^2}{\gamma g}}-h_1.$$

Where h_0 = increase in pressure, h_1 = head of water in feet, S = thickness of pipe walls in inches, B = diameter of pipe in inches, E = modulus of elasticity of pipe material, v = velocity of water in inches per sec., $\gamma = 62.408$ and $g = 32.153$.*

The specific strain K of the pipe walls is figured to $K=\frac{Dp}{2S}$, wherein p represents the specific pressure.

Example.

In a pipe line of 54 in. diameter, water flows with a velocity v=6 ft.; the lowest pipes of sheet steel are ¾ in. thick; the line is under a head of 200 ft. or a pressure of 86.8 lb. per sq. in. To what point will the pressure rise if the flow is stopped suddenly?

According to the formula:

$$h_0=\sqrt{200^2+3\frac{0.75}{54}\times\frac{28\,000\,000\times144\times36}{62.4\times32.153}}-200$$

$$=\sqrt{40\,000+\frac{2.25}{54}\times\frac{4\,032\,000\,000\times36}{108\,342.9}}-200$$

$$=\sqrt{3\,053\,432}-200$$

$$=1\,747-200=1\,547\text{ ft.}$$

The rise of pressure at the assumed, but in reality impossible, sudden closure will be over 1 500 ft., more than seven times p_1. The pipes would be strained

$$k=\frac{D}{2}\times\frac{p}{S}=27\times\frac{672}{0.75}=24\,192\text{ lb. per sq. in.,}$$

which would exceed the elastic limit, but still leaves some safety against rupture. The normal strain of the pipe is:

$$k=\frac{D}{2}\times\frac{p}{S}=27\times\frac{86.8}{0.75}=\frac{2\,343.6}{0.75}=3\,124\text{ lb. per sq. in.}$$

If the pipe was only ⅜ in. thick it would be normally strained 6 248 lb. to the sq. in. At sudden closure the increase in pressure, however, would be less than with thick walls, because the thinner walls can give more.

For $S=\frac{3}{8}$ in.;

$$h_2=\sqrt{40\,000+\frac{1.125}{54}\times\frac{4\,032\,000\,000\times36}{2\,006.35}}$$

$$=\sqrt{40\,000+1\,506\,716}$$

$$=\sqrt{1\,546\,716}=1\,243,$$

which is less than seven times h_1; there is further,

$$k=27\times\frac{540}{0.375}=38\,880,$$

not twice the value of 24 192 found above, as was to be expected with walls of half the thickness.

The formula does not contain the length of the pipe line, which is quite evident; for each foot of length of the energy-carrying water there is a foot of length of energy-receiving pipe wall. This, of course, is correct only with the assumed sudden closure. It will be found in the following what tremendous influence the length of the line has upon the rise of pressure if the closure takes place in a certain determined time, say 2 to 6 seconds; of course, the values will be found smaller than with sudden closure.

Since the velocity v for turbine pipes will always have a maximum between 6 and 9 ft., the modulus of elasticity E for plate steel has a constant value, γ and g also are fixed values, the increase in pressure at sudden closure depends only upon the ratio between the thickness of the pipe and its diameter and upon the pressure to which the pipes are subjected. The example which was figured out above shows that under high heads an absolute safety at sudden closure can be obtained only by extraordinarily increasing the thickness of the pipe, which would considerably increase the cost of the line. It is, therefore, natural that with long pipe lines one introduces safety devices which at sudden closure prevent its rupture. Of course, one finds occasionally such safety devices where there is not the least danger for the pipe line. Such needless installations could happen only because on the subject treated herewith nothing has been furnished anywhere in the technical literature that is useful to the practicing engineer.

The energy taken up by the pipe walls is not destroyed, but the pipe walls will, after stationary conditions are reached again, contract to their original diameter and force back the surplus, but very small, quantity of water into the reservoir, which may be accompanied by some fluctuations back and forth. These conditions will be treated with the discussion of the standpipes.

Increase of Pressure with Definite Time of Closure

The closure of a line can never take place instantaneously; a certain time for moving the closing mechanism will always be required, which might sometimes be very short.

It is to be investigated what rise of pressure will take place at the lower end of a turbine line, if the governor closes the turbine within a certain time, called Closing Time, designated T.

Apparently in this case a moving column of water, whose length is always equal to the length of the pipe line, is first retarded in its motion by increasing the resistances at the section of the discharge and finally stopped entirely. Herewith this column of water causes a shock against the closing apparatus, which is felt in the fluid as an increase in pressure, and, on account of the incompressibility of the water, is transmitted backwards towards the entrance section with decreasing intensity. For determining approximately the greatest increase in pressure, it is sufficient to apply the law of impact, in which the energy contained in the water during the discharge is not deducted, however. It may also be mentioned again that the problem dealt with is a problem of undulation.

One finally finds for the maximum rise for a certain time of closure T,

$$(h)=\frac{\sqrt{h_1^2+3\frac{S}{D}\frac{Fv^2}{\gamma g}}-h_1}{\frac{T}{T_2(h_2)}\sqrt{\left(h_1^2+3\frac{S}{D}\frac{Fv^2}{\gamma g}\right)}+1-\frac{h_2}{(h_2)}\frac{T}{T_2}}$$

where h represents the pressure prevailing at the beginning of the closure. (This is an empirical formula which is developed in full by the author.)

(To be continued.)

* For the mathematical development of this formula the reader is referred to the original paper.

UNNECESSARY LOSSES IN FIRING FUEL OIL.*

By C. R. Weymouth.

Practically all oil-fired boiler plants in stationary practice are subject to hand control throughout. It is customary to maintain a uniform oil pressure at the oil pump and in the oil-pressure main, and to throttle the supply of oil by hand at all of the individual burners. It is also customary to operate with full boiler steam pressure on the main supplying steam to all the burners, and to regulate by hand the supply of steam for atomizing purposes, at each of the individual burners. Boiler dampers also are all subject to hand control on the individual boilers.

In a central station having, say, twenty 500-horsepower boilers, there would be about 60 burners. For economy of labor, there would probably be not more than two or three firemen to the shift, in a plant of this size. On a commercial railway or lighting load subject to the usual fluctuations, such a plant would probably be operated with the rear boiler dampers clamped in fixed positions, wide open or nearly so. The supply of steam to burners would receive little attention, but the supply of oil to the burners would be regulated for variations in load by throttling to the extent necessary for maintaining the desired steam pressure. In such a plant there would be a more or less uneven rate of firing at the various boilers, and an excess of air for combustion at all loads, particularly at the lighter ones corresponding to a nearly uniform rate of flow of air through the furnace. The operators are likely to become careless, not noticing the drop in steam pressure with a sudden increase in load until this has become considerable, necessitating a severe momentary rate of firing in a number of boilers to bring the steam pressure back to the normal. This severe duty increases the expense for repairs to the boiler settings, rate of burning out of tubes, etc.

In certain plants where engineers are enlightened as to the principles of combustion, the attempt is frequently made to operate on a reduced air supply, with the result, if the dampers are set for mean or nominal load, that the chimneys smoke excessively on overloads before the limited number of firemen can reach all the dampers to open them.

As the lamentable result of these conditions, the average boiler plant efficiency with crude oil, even with the best types of boilers, averages much nearer 70 than 80 per cent, which is possible in large plants under proper methods of control.

Probably it will always be impossible to instill into the mind of an ordinary fireman such knowledge of the principles of combustion and the losses due to excess air supply as to obtain economical results in large stations where it is necessary to depend on hand firing. Improved conditions can be secured by the employment of a boiler room engineer whose duty it is to scrutinize all fires from time to time and to coach the firemen in their duties; but the only ideal method seems to be an automatic system of control, such as will be here described, where the various adjustments, having once been made for economical conditions, are automatically repeated for the various conditions of load, maintaining a high average economy from month to month. With well-designed oil furnaces and careful adjustment under uniform load conditions, carefully conducted tests have shown that it is possible to obtain high percentages of CO_2, indicating as low as 10 per cent excess air over the requirements for perfect combustion, with no unconsumed elements in the flue gases.

Numerous data relating to coal fuel are available, showing the importance of reduced air supply as tending to high furnace efficiency; also the relation of excess air supply to any observed percentage of CO_2 and other factors of gas analysis. As few data for oil fuel are available, the following will be presented.

All Pacific Coast crude oils contain a certain amount of moisture, sulphur, nitrogen, and oxygen; the main constituents being carbon and hydrogen. The characteristic difference in oils of different gravities lies in the relative quantities of carbon and hydrogen contained, there being more carbon and less hydrogen in the heavier oils, less carbon and more hydrogen in the lighter. In the better grades of oils treated at the wells before shipment, in which moisture has been largely eliminated, it can be roughly assumed that 3 per cent of the oil is made up of sulphur, nitrogen, oxygen, and water. This relationship is not universal, certain Southern California oils containing a large percentage of sulphur.

The predominating oil used on the Pacific Coast, known as Bakersfield oil, averages about 16 deg. Baume, which is equivalent to 336 pounds of oil per 42-gallon barrel. The ultimate analysis of this oil is about as follows:

Carbon, 85 per cent.
Hydrogen, 12 per cent.
Sulphur, 0.8 per cent.
Nitrogen, 0.2 per cent.
Oxygen, 1 per cent.
Water, 1 per cent.

A number of lighter oils in general use, ranging in the neighborhood of 18 to 20 deg. Baume, would average about as follows:

Carbon, 84 per cent.
Hydrogen, 13 per cent.
Sulphur, 0.8 per cent.
Nitrogen, 0.2 per cent.
Oxygen, 1 per cent.
Water, 1 per cent.

Certain heavier oils ranging from 12 to 14 deg. Baume average about as follows:

Carbon, 86 per cent.
Hydrogen, 11 per cent.
Sulphur, 0.8 per cent.
Nitrogen, 0.2 per cent.
Oxygen, 1 per cent.
Water, 1 per cent.

As a result of tests by Edmond O'Neill, professor of chemistry of the University of California, the calorific value of Bakersfield oil may be taken as about 18,600 British thermal units per pound, allowing for the presence of about 1 per cent moisture as indicated above. When corrected for moisture, the net heat units per pound of oil are proportionally higher, although there is a slight loss in furnace efficiency due to the presence of moisture, inasmuch as all such water is evaporatetd into steam and superheated to the temperature of the escaping gases, involving an amount of heat both sensible and latent.

On the basis of the above analyses, the chemical requirements of air for complete combustion per pound of oil are as shown in Table 1.

In the various text books, the values given range from 16 to 18 pounds of air per pound of oil, but an average of 14 pounds of air per pound of oil is more nearly correct.

The ordinary method of indicating and measuring steam to atomize oil has been to express the quantity as a percentage of the actual amount of water evaporated in the boiler. This percentage ranges from about 2 to 5 and over, depending on the system of oil burning, type of burner, etc. While such a percentage rating is no doubt convenient, it is inaccurate, in that the steam consumption of oil burners is proportional to the oil burned and not to the water evaporated. Various tests have shown that the steam consumption of oil burners ranges from 0.14 to over 0.5 pound of steam per pound of oil. The average value of good performance is about 0.3 pound of steam per pound of oil, although with hand regulation on variable load this quantity should be slightly increased, and is somewhat dependent on the gravity of the oil, temperature at the burners, etc. In stationary practice, the use of air for atomizing purposes has been practically abandoned.

* Presented at the annual meeting (December, 1908) of the American Society of Mechanical Engineers.

TABLE 1. WEIGHT OF AIR REQUIRED FOR COMBUSTION OF OIL OF DIFFERENT GRADES.

Grade of Oil	Light	Medium	Heavy
Per cent of C	84.00	85.00	86.00
Per cent of H	13.00	12.00	11.00
Per cent of S	0.80	0.80	0.80
Per cent of N	0.20	0.20	0.20
Per cent of O	1.00	1.00	1.00
Per cent of H_2O	1.00	1.00	1.00
Calculated air per pound of oil chemically required—pounds	14.25	14.02	13.79
Corresponding maximum per cent CO_2 by volume—dry gases of combustion, per cent	15.16	15.52	15.89

As no direct experiments have been made showing the loss in boiler efficiency due to various percentages of excess air supply, the writer will present some simple calculations showing the amount of this loss.

It is well known that the loss due to an excess of air supply is not only on account of the direct loss in heating the added air to the temperature of the flue gases, but there is a secondary loss due to the fact that, corresponding to an excess of air, there results a higher flue temperature not only for the actual amount of air necessary for combustion, but for all such excess air. Calculations as to boiler performance are simplified with oil fuel, as practically complete combustion is secured in a well-designed furnace, the carbon and carbon monoxide usually being burned to CO_2. The stack losses include the sensible heat contained in the dry gases of combustion, the sensible and latent heat in the steam from the combustion of hydrogen and oxygen and in the steam introduced through the burner, and the moisture present in air for combustion.

Assuming complete combustion, and employing a boiler radiation loss of 3 per cent, the writer has calculated the boiler efficiency, at rating, for various percentages of excess air supply, as given in Table 2.

TABLE 2. BOILER EFFICIENCY FOR EXCESS AIR SUPPLY.

Excess air supply, per cent	10	50	75	100	150	200
Assumed temperature escaping gases, deg. fahr	400	450	475	490	Over 500	Over 500
Corresponding ideal efficiency of boiler per cent	84.2	80.27	77.66	75.22	Under 70.94	Under 67.09
Possible saving in fuel due to reduction of air supply to 10 per cent excess, expressed as per cent of oil actually burned under assumed conditions	0	4.67	7.78	10.68	Over 15.76	Over 20.32

The 3 per cent used for boiler radiation is subject to some variation, being greater in small boilers and less in large units. For medium units, 3 per cent is probably very close.

The stack temperatures for any particular type of boiler, for any given load and corresponding to any assumed per cent of excess air, will vary with the size of boiler, arrangement of heating surface, character of baffling, condition of heating surface, etc. Stack temperatures will also vary with the different types of boilers corresponding to these factors. The temperatures given corresponding to the stated air supply, from 10 to 100 per cent excess, are those to be expected in ordinary practice and necessarily approximate; with boilers having three passes of gases and sinuous headers, the temperatures in general will be lower than those indicated; with boilers having but one pass and flow of gases parallel to tubes, the temperatures in general will be higher than indicated.

Very few data are available for the temperatures corresponding to 150 and 200 per cent excess air, and the corresponding figures are given merely to show in a general way the magnitude of the losses easily resulting from careless firing of crude oil. The flue temperatures assumed are also subject to variation dependent on the rate of forcing the boiler and other well-known elementary factors. The excess air with careless oil burning is usually greater than with careless coal firing, because of the greater excess draft power of chimneys. In the preceding table, the writer has calculated the saving that could be effected by reducing the air supply from that specified to an ideal condition assumed to correspond to 10 per cent excess air. This saving in fuel is of vast importance, but has been almost completely neglected with oil fuel.

It is possible to obtain a fair notion of the percentage of excess air from a mere determination of the amount of CO_2,—that is, assuming all hydrogen having been burned to H_2O and all carbon to CO_2. Any simple formula involving the element CO_2 must be dependent on an assumed percentage of hydrogen in the oil fuel, but inasmuch as the hydrogen contained is fairly uniform for any given grade of oil, there is but little error in such an assumption.

TABLE 3. POUNDS OF AIR PER POUND OF OIL AND RATIO OF AIR SUPPLIED TO THAT CHEMICALLY REQUIRED.

Per cent CO_2 by volume as shown by analysis dry chimney gases	Light Oil C, 84 per cent; H, 13; S, 0.8; N, 0.2; O, 1; H_2O,1		Medium Oil C, 85 per cent; H, 12; S, 0.8; N, 0.2; O, 1; H_2O, 1		Heavy Oil C, 86 per cent; H, 11; S, 0.8; N, 0.2; O, 1; H_2O,1	
	Pounds of air per lb. oil	Ratio air supply to chemical requirements	Pounds of air per lb oil	Ratio air supply to chemical requirements	Pounds of air per lb. oil	Ratio air supply to chemical requirements
4	51.40	3.607	51.93	3.704	52.45	3.803
5	41.31	2.899	41.71	2.975	42.12	3.054
6	34.58	2.427	34.90	2.490	35.23	2.554
7	29.77	2.089	30.04	2.143	30.31	2.198
8	26.17	1.836	26.39	1.883	26.62	1.930
9	23.37	1.640	23.56	1.680	23.75	1.722
10	21.12	1.482	21.29	1.518	21.45	1.555
11	19.83	1.391	19.43	1.386	19.58	1.419
12	17.76	1.246	17.88	1.276	18.01	1.306
13	16.46	1.155	16.57	1.182	16.69	1.210
14	15.36	1.078	15.45	1.102	15.55	1.127
15	14.39	1.010	14.48	1.033	14.57	1.056

Table 3 shows the calculated weight of air per pound of oil and the ratio of actual air supply to chemical requirements, for the various grades of oil and various percentages of CO_2. Under the present systems of firing, the amount of CO_2 present in the flue gases is often as low as 4 or 5 per cent. With an ample supply of labor and a careful and scientific adjustment of dampers by hand, the percentage of CO_2 under an ideal and uniform load can be maintained as high as 13 per cent. With automatic control and under variable load conditions, it has been found possible to maintain a high percentage of CO_2 conforming very closely to ideal conditions.

A JOVIAN CORRECTION.

At the sixth annual meeting of the Rejuvenated Sons of Jove, held in Buffalo, N. Y., Mr. Alex. Henderson, of New York City, offered a resolution that at the close of each annual meeting the assembled Jovians drink a standing toast to the First Jupiter, Chas. W. Hobson, No. 1, of Dallas, Texas, to the following sentiment:

"A single rose leaf passed before a man while he is alive is productive of more happiness and joy than a mountain of flowers heaped upon his grave."

In the account of the proceedings of that meeting, prepared for and published by the electrical press of the country, the beautiful sentiment, given above, unfortunately, was quoted incorrectly, entirely robbing it of its delicate fragrance. In justice to Mr. Henderson, and in justice to the sentiment itself, we publish the correct quotation, at the request of the writer of the original article.

CURRENT COMMENT

Sileo-vanadium steel is now used in making transformers, as on account of its improved magnetic quantity it decreases the core loss.

Electric traction in Great Britain is used solely on 216¼ miles and partly on 182 miles of road. There are 86 electric locomotives, 806 motor cars and 1,275 trailers in use on these railways.

Electric lighting on the Canal Zone has been completed between La Boca and Gorgona, thus giving light to every village and hamlet on the line. A 400-k.w. generator added to the equipment of the Empire power plant supplies current for the 1,185 lamps which have been added.

Electrification of the Ouest Railway lines entering the Saint Lazare Station in Paris is to be started. High-tension three-phase current is to be transmitted by underground cables to transformer stations along the lines from Paris to Saint Germain and Argenteuil. Current at 650 volts is to be supplied by a third-rail system.

Ohm's law fails when ionized gases are conducting electric current. If the distance between the terminal plates be halved, only half the number of ions will be formed and hence the current will be halved instead of doubled. Up to the point of saturation the current is directly proportional to the voltage, but above this point there is no further increase in current.

Electrical banks are being formed in Germany to finance electrical undertakings. Money will be advanced to large or prospective users of electric light and power so that they can make improvements or carry out new work. Repayment is to be made in the form of annuities. The companies concerned in this are the Allgemeine Co., the Siemens & Halske Co., and the Felton & Guilleaume-Laymeyer Works Co.

The tax on electricity and gas in Italy has been in use since 1895. There is no tax on the use of electricity or gas for industrial purposes nor for public lighting of streets and squares, nor for any other purpose except private lighting and heating. No tax is charged on heating for industrial purposes. The tax amounts to 0.4 cent for each cubic meter of illuminating gas made from coal, 1.6 cents for each cubic meter of illuminating gas made from mineral oil, and 1.2 cents for each kilowatt-hour of electrical energy.

Creosoted ties are to be used for the main tracks of the Pennsylvania Railroad. A tie-treating plant is being built at Mt. Union, Pa., and two large creosote storage tanks are to be located at Greenwich Point, Philadelphia, Pa. The Mt. Union plant will be the first creosoting operation undertaken on a large scale by an Eastern railroad. It is estimated that proper treatment will increase the life of cross-ties from two to three fold. Applied to all of the 100,000,000 ties which American railroads use annually, it would greatly reduce the drain on the rapidly-decreasing timber resources. The Pennsylvania Railroad alone uses from 3,500,000 to 4,000,000 ties each year. The average life of these red oak and chestnut ties under present conditions is from three to four years, while white oak lasts from seven to eight years.

The turbinal tubeless boiler is made of concentric annular conical vessels with narrow water spaces and narrow flame spaces, heated by a liquid fuel burner from below. The steam produced in the boiler proper descends through a helically-coiled superheater tube placed in the middle space of the innermost cone. The issuing steam is dried and comes out at a high temperature, something that may be over 600° F. It might have been anticipated that with such narrow water spaces all the water would have passed off as foam or priming, but somehow the boiler, when at work, appears to resolve itself into one of the semi-flash variety, and works well.

A human storage battery is the latest example of humorous "newspaper science." "A seven-year-old Russian boy has been discovered to be a human storage battery of electricity," says the New York American. "His strange powers were accidentally discovered by a metal filling which had been put in one tooth. The boy picked up the disconnected porcelain knob that was used to connect an electric fan with an electric light wire and thrust it into his mouth. As the metal cap touched the metal tooth filling the fan began to revolve and then to buzz at full speed. A thirty-two-candlepower bulb was attached to the end of the wire and the light burned brilliantly. When a steel thimble was put on the boy's finger and he grasped the end of the wires in his hand the same result was obtained. A piece of iron held in the boy's hand for a few moments becomes highly magnetized. A hammer with an iron handle held in his hands will attract tacks at a distance of four feet. Placed on a glass-legged stool, any one touching him received a distinct shock. An ordinary flat iron held in his hands for five minutes and then passed over tenpenny nails driven into hard wood will pull them with ease! ! !"

A tax on electricity and gas is proposed in a bill just introduced in the German Reichstag. It is proposed to levy a tax of five per cent on the selling price of electric current, with a maximum of 0.4 pfennig per kilowatt-hour. Current generated for private use is to bear a tax of 0.4 pfennig per kilowatt-hour, with a reduction to five per cent of the cost of production, when it can be proven that the above rate is in excess of this percentage. Gas is to bear the same rate of taxation per cubic meter of gas sold as the kilowatt-hour of electricity. Electrical installations of not over one-and-one-half kilowatts capacity are to be exempt from taxation. If the product is imported from a foreign country, the receiver is to pay the tax; if it is exported, the exporter is to pay the tax. All electrical illuminants, as well as incandescent bodies for gas, alcohol and oil lamps, are also to bear their burden of taxation.

Coal gas in the United States in 1907, as reported by the 513 companies that made returns to the United States Geological Survey, was 58,096,478,402 cubic feet. Of this product 3,399,680,509 cubic feet were lost through leakage, fire, or otherwise and were reported as unaccounted for. The net product sold, therefore, amounted to 54,696,797,893 cubic feet, which was valued at $36,327,879, or an average of 66 cents per thousand cubic feet. Statistics of this product for 1906 were not published by the Survey, but those for 1905 show that the total quantity of gas sold in that year was 40,454,215,132 cubic feet, valued at $32,937,456, an average of 81.4 cents per thousand cubic feet, so that while the quantity of gas sold increased 14,242,582,761 cubic feet, or 35 per cent, from 1905 to 1907, the value increased only $3,390,423, or 10 per cent, and the average price per thousand cubic feet showed a decline of 15.4 cents. This apparent decline in value is attributed chiefly to the greatly increased production of by-product oven gas, most of which is used for fuel and all of which is sold at first hand at much lower rates than those obtained for gas produced as a primary product of gas works.

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POWER AND GAS

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DIRECTORS

R. J. DAVIS A. M. HUNT E. M. SCRIBNER C. L. CORY E. B. STRONG

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Quantitative Pressure Determinations

There is said to be nothing more changeable than the whim of a woman. One exception, perhaps, is the load carried by a great hydro-electric plant that supplies the heterogeneous light and power needs of several communities. For the satisfactory operation of such water wheels, under the many changes of load to which they are subject in electric service, several methods have been devised. In addition to the storage of energy in the fly wheel or battery, there are excellent governors on the market which accomplish this result.

While differing much in individual detail, these governors all have one point in common—their purpose is to vary the amount of water delivered to the wheels, thereby keeping constant the speed, which would otherwise vary with the load. This variation in speed is the cause of the annoying fluctuations in the brightness of an incandescent light, and to it the unsatisfactory operation of motors is often due. The desired uniformity of speed is attained at the cost of either much wasted water or of great strain induced by pressure in the system. As water is often scarce, this waste is undesirable, and consequently the problem is met as far as possible by pressure regulation. This regulating function of the mechanical governor, by the way, is analogous in many respects to the governmental regulation of corporations, which is now causing so much discussion.

Like any energy that is misdirected, this resultant pressure is capable of doing great damage. It is not practical to build pipe lines which are substantial enough to resist the enormous pressure that results when hundreds of tons of water flowing at high speed are abruptly arrested. The familiar water hammer is the audible expression of such sudden stoppages, which produce a wave similar to the vibrating sound wave in an organ pipe. This oscillatory wave may even become cumulative, with consequent pressure increase great enough to destroy the strongest construction.

Gradual stoppage by means of special gates reduces the pressure considerably, and together with some relief vent has made possible the successful operation of hydraulically driven generators, with economy of water and minimum of shock under variable load. These relief vents include air chambers, standpipes, safety valves, and by-passes, either singly or in conjunction.

These conditions thus briefly outlined are familiar to every hydraulic engineer, and in many cases the problems arising in connection with them have been satisfactorily solved, usually by the method of "cut and try." The knowledge has been qualitative rather than quantitative. Therefore the formulae and description as to what actually takes place in a pipe line as shown by PROF. A. BUDAU in this issue are of the greatest value.

PERSONAL.

John Llewellyn, of the Western Elevator Company, Los Angeles, is making a New Year's visit in San Francisco.

Harry J. Jastro has been appointed manager of the Bakersfield Power, Transit & Light Co., of Bakersfield, California, succeeding the late James Goodwin.

Harry K. Fish, Los Angeles representative of the General Electric Company, is in San Francisco to attend the annual sales conference of his company, which is being held here.

J. H. Lane, chief operator of the La Grange Water & Power Company, La Grange, Stanislaus County, California, was in San Francisco last week.

Ralph L. Phelps, of the San Francisco office of the Safety Insulated Wire and Cable Company, returned from a brief visit to Los Angeles on Wednesday of this week.

F. H. Poss, Pacific Coast representative of the Benjamin Electric Mfg. Co., and of the Holophane Co., Honolulu, expects to sail for Honolulu on January 9th.

Robert Howes, electrical engineer, formerly American Bank Building, Seattle, is engaged in consulting work for the British Columbia Electric Railway Company, and for the next few months will make his headquarters in Vancouver, B. C.

Gifford Pinchot, Forester, is making a trip to Mexico and Canada, bearing invitations from President Roosevelt to President Diaz, of Mexico, and Premier Laurier and Lord Gray, of Canada, to appoint delegates to the National Conservation Conference, to be held in Washington on February 18th.

F. N. Boyer, of Chicago, accompanied by Mrs. Boyer, who has been spending a few days in San Francisco, left for Honolulu on the steamer Korea, on December 22d. Mr. Boyer is in charge of the supply department of the General Electric Company at Chicago, and has been spending some months on the Pacific Coast, recuperating from the effects of severe work during the past year or two. Mr. and Mrs. Boyer expect to return from Honolulu some time in March, 1909.

Walter J. Jones, who has been associated for the past three years with the late Dr. F. A. C. Perrine, will continue the consulting-engineering business of Dr. Perrine at the old offices, 60 Wall Street, New York City. Mr. Jones is carrying through to completion the work that Dr. Perrine had on hand at the time of his death, including work for the Bishop Creek Gold Company for a power plant, stamp mill, and hydraulic mining installation for the British Guiana Gold Company. He is consulting engineer for the United States Roller Bearing Company, and for the Interstate Railways Company. For the latter he is building a power plant of 10,000 kilowatts at Reading, Pa. This will involve the building of the power plant and changing of the present steam plant into a main synchronous-converter sub-station from which will be operated the street railway system, low-tension lighting and power system, and street arc lamps of Reading. There will also be installed four or five other sub-stations in the vicinity of Reading, to supply the inter-urban trolley systems. The plants include the re-equipment of the water-power plant, which is located about six miles from Reading.

TRADE CATALOGUES.

Electrical Equipment for Textile Mills is the subject of Bulletin No. 5910-10 from the Western Electric Co. It illustrates some interesting applications of electric drive.

"Fan Motors for 1909" is the subject of a catalogue just issued by the General Electric Company. This catalogue contains illustrations, descriptive matter and prices of the entire line of General Electric fan motors for the coming season. This line embraces motors for both alternating and direct current, in desk, bracket, ceiling, floor column and counter-column types of standard sizes. It lists, also, ventilating motors and miscellaneous small power motors for alternating and direct current, as well as various supply parts of the standard fan motors. The catalogue, No. 4632, is attractively printed in colors, and will be furnished on application to the nearest sales office, or to the Publication Bureau, Schenectady, N. Y.

TRADE NOTE.

The Phoenix Glass Company, of New York, Pittsburg and Chicago, has retained the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York, to act as consulting and designing illuminating engineers, in the matter of designing or re-designing glass globes and reflectors, as manufactured by them. Mr. Albert J. Marshall, chief engineer of the Bureau, will have direct supervision of this work.

The Aylsworth Agencies Company have moved their offices from New Montgomery and Minna Streets to rooms 405-6 Atlas Building, 604 Mission Street, San Francisco. They represent the following companies: Alphaduct Co., Jersey City, N. J.; Electric Goods Manufacturing Company, Boston, Mass.; Francis Keil & Son, New York, N. Y.; Apple Electric Company, Dayton, Ohio; Monarch Telephone Manufacturing Company, Chicago, Ill.; American Conduit Manufacturing Company, Pittsburg, Pa.; American Electric Fuse Co., Muskegon, Mich.; The Electro-Ad. Company, Detroit, Mich.; Standard Electric Time Company, Waterbury, Conn.; and Chicago Coil Company. E. H. Parrish has recently acquired an interest.

CHRISTMAS TREE CUSTOM UPHELD.

The country's forests again have been called upon to supply about four million Christmas trees, and again many persons have asked themselves and have queried the United States Forest Service, "Is the custom a menace to the movement for forest preservation?"

In the millions of happy homes over the country where the younger generation has made the Christmas tree the center of play since early Friday morning, there are many mothers and fathers who have given the question more or less thought. From Sunday Schools and other organizations also, which hold an annual celebration around a gayly-trimmed evergreen for the benefit of the little ones, has come the question whether it is consistent to urge conservation of forest resources and then to cut millions of young trees every year to afford a little joy in the passing holiday season.

"Yes, it is consistent and proper that the custom should be maintained," has been the answer of United States Forester Gifford Pinchot in every case. "Trees are for use, and there is no other use to which they could be put which would contribute so much to the joy of man as their use by the children on this one great holiday of the year.

"The number of trees cut for this use each year is utterly insignificant when compared to the consumption for other purposes for which timber is demanded. Not more than four million Christmas trees are used each year, one in every fourth family. If planted four feet apart they could be grown on less than 1,500 acres. This clearing of an area equal to a good-sized farm each Christmas should not be a subject of much worry, when it is remembered that for lumber alone it is necessary to take timber from an area of more than 100,000 acres every day of the year.

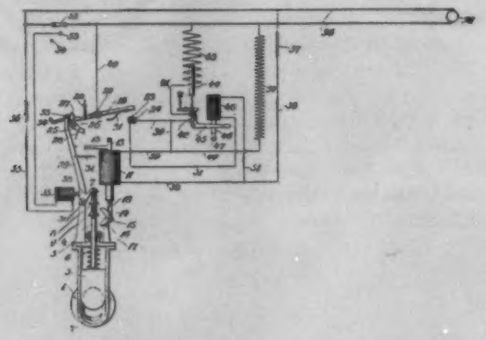
"It is true that there has been serious damage to forest growth in the cutting of Christmas trees in various sections of the country, particularly in the Adirondacks and parts of New England, but in these very sections the damage through the cutting of young evergreens for use at Christmas is infinitesimal when compared with the loss of forest resources through fires and careless methods of lumbering. The proper remedy is not to stop using trees, but to adopt wiser methods of use.

"It is generally realized that a certain proportion of land must always be used for forest growth, just as for other crops. Christmas trees are one form of this crop. There is no more reason for an outcry against using land to grow Christmas trees than to grow flowers."

PATENTS

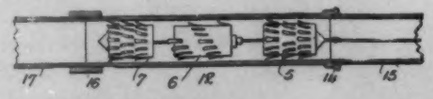
ELECTRIC WATER-VALVE. 906,509. George P. Carroll, Bridgeport, Conn.

In combination a casing having a port, means adapted to open or close port, automatic means for opening port by the application of electric power to former means when such power



is also applied for other purposes and for closing port through former means when the electric power is turned off from being used for other purposes, and automatic means operative when the power used for other purposes exceeds a predetermined limit to further open port.

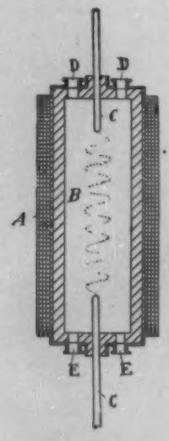
ART OF CLEANING PIPE-LINES. 906,595. George F. Whitney, South Orange, N. J., assignor to National Water Main Cleaning Company, New York.



The combination of a pipe provided with a sleeve on one end and a cleaning device located within the pipe, pipe being adapted to be inserted into and form a portion of a pipe line or main.

ELECTRIC FURNACE. 906,682. Kristian Birkeland, Christiania, Norway.

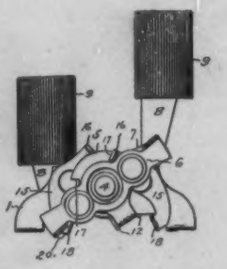
In an electric furnace for the treatment of gases having



their electrode points a distance apart greater than that permitting the automatic formation and restarting of the arc between them and means to distort this arc into a helix.

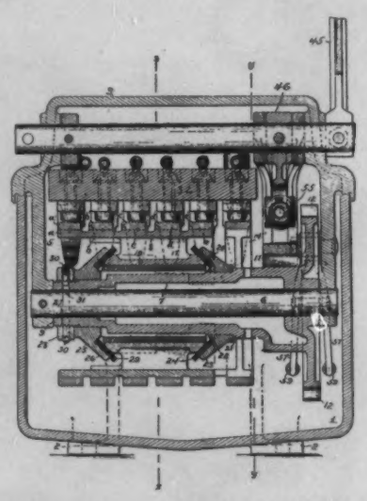
PUSH-BUTTON ELECTRIC SWITCH. 906,740. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn.

A push button switch mechanism having a supporting plate, a spindle supported by plate, a lock plate mounted upon spindle, levers pivoted on the supporting plate and adapted to engage the lock plate, a spring carried by the supporting plate and engaging the lower ends of the locking levers and adapted to hold the upper ends of levers in engagement with the lock plate, a



yoke mounted on the spindle, push buttons connected with the yoke, an actuating spring with its ends engaging lugs projecting from the yoke and the lock plate, and feet projecting from the lower ends of the locking levers into the path of the tips of the push button shanks whereby the levers are disengaged from the lock plate when the spring is under sufficient tension, by the engagement of the tips of the push button shanks with the feet, substantially as specified.

ELECTRIC CONTROLLER. 906,576. Clarence L. Taylor, Alliance, Ohio, assignor to The Morgan Engineering Company, Alliance, Ohio.



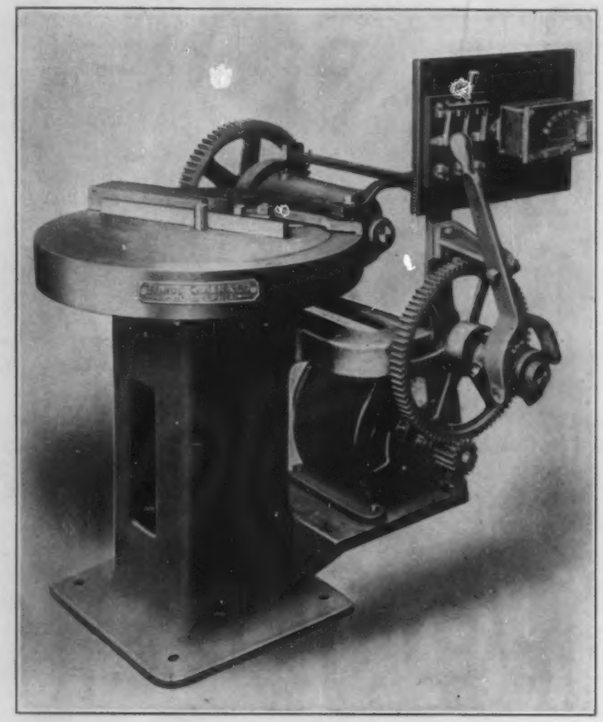
In an electric controller, the combination with a casing adapted to contain oil, and a cover having hinged connection with said casing, of a contact drum, contact fingers, and operating mechanism, all supported by and removable with hinged cover.

INDUSTRIAL

A NEW BENDING TESTING MACHINE.

The Olsen special testing machine shown in the accompanying illustration is designed for the "cold bend" testing of iron and steel specimens. The "cold bend" test is today specified by a great many manufacturers for a great deal of iron and steel, and the use of this machine greatly facilitates the process.

By the method heretofore used, bending tools were inserted in an ordinary tension testing machine. This required considerable time for setting the machine, which could be more profitably used for tension testing alone.



A New Bending Testing Machine

With this machine it requires only three minutes to bend a specimen double, that is, 180 degrees around a pin. The saving of time by the use of this machine for this special purpose in place of the old type of machine, is of great advantage to a steel mill or other establishment, where a great many tests must be made in a short time.

The machine is intended for making a "cold bend" test on iron or steel specimens up to a size of one inch square or equivalent. The specimen is bent around a pin of a diameter equal to its own thickness. Any size of pin up to two inches in diameter may be used, the smaller sizes being reinforced to withstand the bending pressure. The pins have taper shanks so that they can readily be changed to suit the different sizes of specimens. In order to insure ready release from the taper fit, a knockout pin is provided, which, when tapped with a hammer, releases the bending pin. Provision is made for placing the bending pin at varying distances from the center as required. A taper liner at the back of the specimen serves for the adjustment of the various sizes of specimens to be tested.

The outer circular edge of the machine is graduated for every five degrees, so that the specimen may be bent to any desired angle up to a complete bend of 180 degrees.

A small Westinghouse electric motor is mounted on a bracket at the rear of the outfit, so that the entire unit may be located wherever desired to give the greatest convenience of access. The motor is known as a type "R" direct current, 1¼ horsepower, and runs at 1,250 revolutions per minute, furnishing ample power to bend the largest specimens used in the machine. The motor is controlled by a switch and starting rheostat, which are mounted just above the handle of a clutch on the first gear reduction shaft. From this lever the operation of the machine is controlled by hand. To prevent damage to the outfit, an automatic stop is provided which will mechanically throw out the motor switch at the end of the return stroke if the attendant should forget to operate the hand lever. The reverse motion of the table is obtained by reversing the motor by a double throw switch.

The machine is manufactured and sold by Tinius, Olsen & Company, of Philadelphia.

ENAMELED WIRE.

The American Electric Fuse Company, of Muskegon, Mich., has been developing a black enameled wire, the insulation of which is said to possess the qualities of toughness, tenacity and adhesiveness, together with positive dielectric strength and uniformity in quality and thickness. The hydrocarbon form of black enamel used is a closely adhesive film which is said to stretch with the wire and to withstand all the handling incidental to the manufacture of the wire into apparatus. The insulation is non-hydroscopic, and is claimed to withstand a temperature of 600 deg. Fahr. without charring, burning or materially injuring the coil. The enamel dissipates heat faster than silk or cotton and being inert as regards the action of ordinary chemicals is not detrimental to the wire itself. Its thickness is about one-quarter that of single silk for the same break-down voltage. This thinness of insulation results in saving space, and since the density of a magnetic field is directly proportional to the number of lines of force for unit of area of cross section, the advantage of such material in electrical work is evident.

HYDRAULIC TURBINE FOR NELSON, B. C.

A 1,250-horsepower hydraulic turbine has been built at the Scranton works of the Allis-Chalmers Company for the power house of the city of Nelson, B. C. The turbine and vertical alternator are both of Allis-Chalmers Company's standard design, and, after extensive tests in service, were found to be even more efficient than was claimed for them by the builders. The turbo-generator has a normal capacity of 750 kilowatts, but during the test run, at which the city officials of Nelson were present, this output was increased to 1,340 kilowatts for a period of over forty-five minutes' continuous running, without undue increase in temperature of bearings.

Up to the time of installing this unit the lighting and power loads for the city had been supplied by the West Kootenay Power and Light Company, situated just across the Kootenay River from the new city power plant, the river being the source from which both plants derive power.

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—Northwest Gas Equipment Company, E. H. Corbett et al.

SEATTLE, WASH.—Pasco Power and Water Co., W. H. Parry, H. K. Owens et al.

BAKER, WASH.—Skagit River Telephone & Telegraph Company, $10,000; J. C. Eden, E. J. Kellogg.

LOS ANGELES, CAL.—The Provident-Midway Oil Company, with a capital stock of $250,000, has been incorporated in this city, by T. O. Turner, W. Le Moyne Mills, L. B. Howe, C. R. Foster, and E. D. Foster.

SAN FRANCISCO, CAL.—The Nevada Petroleum Company has been incorporated here, with a capital stock of $1,000,000, shares $10 each, and $5,000 subscribed, by M. L. Requa, F. W. Bradley, J. S. Wallace, A. C. B. Fletcher, and C. A. Norris.

ROSLYN, WASH.—The Cle Elum-Roslyn Railway & Power Company has been incorporated for the purpose of building and operating an electric railway from Cle Elum to Roslyn. Capital stock, $100,000. Incorporators: Frank S. Farquhar and W. E. Farquhar.

WALLA WALLA, WASH.—The Columbia & Walla Walla Traction Company has been incorporated to construct an electric railway from Dayton to Wallula. Capital stock, $1,000,000. Officers: N. G. Blalock, president and general manager; M. R. Hanger, of Dayton, first vice-president; L. C. Davison, secretary; George Kellough, treasurer.

PHOENIX, ARIZ.—Articles of incorporation of the Phoenix, Tempe & Mesa Railway Company have been filed with the territorial auditor. The capital stock is named at $2,000,000, the object of the company being to construct a double-track electric line between Phoenix, Tempe and Mesa, the road to be finished before December of 1909.

HOOD RIVER, ORE.—Articles of incorporation have been filed by the Watt Development Co. Dr. J. F. and A. S. Watt, of Hood River, are the owners. The company owns valuable water rights and power five miles from Hood River on the river by that name, known as the Truckee power site. Development will start immediately. From 8,000 to 10,000 horsepower is available.

TRANSPORTATION.

LOS ANGELES, CAL.—P. James has filed an application with the Supervisors for a franchise for an electric road on Stephenson Avenue and Whittier Road.

GLOBE, ARIZ.—George W. P. Hunt has petitioned the City Council for a franchise for an electric street railway through Globe, agreeing that construction shall be completed within two years.

UPLAND, CAL.—W. G. Kerchhoff, representing a company of electric railway people, has reached an agreement with the Town Trustees regarding the entry here of a proposed line from Claremont. The company has filed a $10,000 bond as a guarantee of its good faith.

BISBEE, ARIZ.—The fight for the old right of way of the El Paso & Southwestern Railway between Bisbee and Douglas has been decided in favor of the Cochise County Electric Railway Company by the general commissioner of the United States land office at Washington. The publication of future plans of this company are being awaited with great interest, as an electric road would prove of great interest to the community.

FINANCIAL.

MADERA, CAL.—The election for the purpose of voting for sewer bonds in the sum of $25,000 and water bonds in the sum of $50,000, will be held January 7th.

BISBEE, ARIZ.—The City Council has passed an ordinance providing for the issuance of bonds of this city to the amount of $125,000, for the construction of municipal waterworks.

BISBEE, ARIZ.—The offer of the Luvene Company, of Chicago, for bonds, has been accepted by the City Council The bonds consisted in $125,000 for street improvements and $125,000 for waterworks. The Luvene Company bid $250,150.

TUCSON, ARIZ.—Final papers have been drawn up for the transfer of the Benson Electric Light & Water Company's plant to a party of Chicago capitalists. It is understood that they will make extensive improvements to both plants in Benson.

PASADENA, CAL.—Mayor Early of this place has announced that during the latter portion of January or the first of February the City Council will call an election for the purpose of voting bonds to complete the municipal electric light plant. It will cost in the neighborhood of $150,000 to complete the plant.

WATERWORKS.

LOS ANGELES, CAL.—Sealed bids have been received by the Board of Water Commissioners of this city for 1 engine lathe, 1 drill press and 1 sharpener.

PORT ORCHARD, WASH.—The City Council has passed a franchise granting to A. S. Eubanks and George Cady Johnson the right to lay water mains in Port Orchard streets.

SAN MATEO, CAL.—A member of the Board of Trustees has recommended that a four-inch main be run down Cypress Avenue to H Street, and that hydrants be installed at the intersections of various streets.

SAN BERNARDINO, CAL.—Franchises have been awarded by the County Supervisors to the Bloomington Land Company's Domestic Water Pressure System to install pipe lines over certain streets of Bloomington townsite.

SAN BERNARDINO, CAL.—The Muscoy Water Company, owners of Glen Helen ranch, is planning to carry irrigation water through pipe lines instead of open ditches, as at present. The work will entail the laying of about four miles of pipe line.

OAKLAND, CAL.—Resolutions demanding speedy and favorable action of the City Council in installing a salt-water auxiliary system of fire protection were adopted this week by the directors of the Oakland Chamber of Commerce. The resolutions aver that the delay in the installation of the salt-water system has been instrumental in keeping up the high rates of insurance at present in force in Oakland.

ALAMEDA, CAL.—Louis Titus, president of the People's Water Company, has assured the members of the Alameda City Council that the company would keep its promise to install new pipes in Alameda. Six months ago the company promised to put in $7,000 worth of new pipes. Titus explained that only half of this amount had been installed because the company was busy on all sides with betterments that were absolutely necessary, and found it impossible to attend to all as quickly as desired. Titus said that during the last three years the People's Water Company and its predecessor, the Contra Costa Water Company, had installed $18,000 worth of new service, representing an increase in population in Oakland, Alameda and Berkeley of 100,000.

OIL

MEXICO.—E. H. Harriman is reported to have purchased 50,000 acres of oil land in the Tuxpal District, Maxico, where oil has reecntly been discovered.

ESCONDIDO, CAL.—Arrangements have been made by F. M. Jones, representing the Standard Oil Company, for the erection of two steel oil tanks on the company's property in Escondido, each tank to have a capacity of 20,000 gallons.

REDONDO, CAL.—The Amalgamated Oil Company has leased two blocks of land between the Standard Oil Company's tanks and the power plant and will erect supply tanks and a pumping plant. A pipe line is to be laid, according to the plans, to the end of wharf 1, to facilitate loading. More than $40,000 is to be expended in the work.

FRESNO, CAL.—Emil, Hugo, Adolph and Charles Kreyenhagen have leased for ten years to Robert Koenitzer of St. Louis certain oil lands, operations to begin in 60 days and actual work of drilling in 90 days, to be continued for a depth of 3,000 feet to produce ten barrels a day wells, at least ten wells to be completed one after another if the land is proven oil-bearing and these to be kept producing during the lease unless the price of oil is less than 30 cents per barrel. The Kreyenhagens will receive for the lease one-eighth interest in all oil and one-eighth of gross receipts from gas, minerals and other sold products of the leasehold.

TELEPHONE AND TELEGRAPH.

CENTRALIA, WASH.—Oscar Foote is seeking a telephone franchise in this place.

CENTRALIA, WASH.—The Pacific Telephone & Telegraph Company has appropriated $35,000 to put in an entirely new system in Centralia.

CENTRALIA, WASH.—The County Commissioners granted a telephone franchise to the Mountain View Farmers' Telephone Company.

MOUNT VERNON, WASH.—The Farmers' Mutual Telephone Company No. 2 has been granted a franchise to build and operate a telephone system in this city.

STEPTOE, WASH.—The members of the telephone company owning farmers' line No. 3 held a business meeting recently and decided to reconstruct the line.

MODESTO, CAL.—The Board of Supervisors of Stanislaus County has granted permission to Mr. Harris, representing interested parties, to erect a telephone line along certain portions of the County Road.

SONORA, CAL.—The Tuolumne Water Power Company has made application for a franchise granting to it the right to construct and operate a telephone line in Sonora. Sealed bids are to be received up to February 1, 1909.

VALLEJO, CAL.—Several prominent Solano County capitalists are negotiating with the Pacific Telephone & Telegraph Company for the purchase of the Suisun, Benicia, Fairfield, Vacaville, Elmira, and Dixon systems the company. Among the men interested in the deal are Attorney T. T. C. Gregory, president of the Vallejo & Northern Electric Road; County Assessor E. E. Long, and William Pierce. O. A. Haydenfeldt represents the telephone company in the proceedings.

MARE ISLAND, CAL.—Master Electrician George E. Hanscome is anxious to install a more powerful wireless station at Mare Island Navy Yard, stating that this is needed in order that operators may get into communication with stations 3,000 miles distant. Mr. Hanscome recently returned from Alaska, where he attended to the installation of a new wireless station near Valdez. While in the North, Mr. Hanscome was able to get into communication with the Honolulu station from Sitka. Another reason advanced by the master electrician for the installation of a more powerful plant at Mare Island, is that the interference with Government messages, caused by the many small experimental stations about the bay, would be done away with in this event.

MOUNT VERNON, WASH.—The telephone committee reported in favor of the franchise of the Independent Telephone Company, which agrees to establish free telephone connections between this city and Conway, Fir, Sedro-Woolley, and Burlington, and agrees to give the city an efficient service.

WINLOCK, WASH.—Oscar Foote, who this week applied for a telephone franchise in Centralia, also seeks one in Winlock. There is not expected to be any objection to the plan, and it is stated that Mr. Foote contemplates spending about $8,000 in Winlock.

SANDPOINT, IDAHO.—Extensive improvements are planned in the Pend d'Orielle national forest next year. Three new telephone lines will be built, the first from Sandpoint to Cocolalla and thence to Bridgeview ranger station; the second from Athol around the upper end of the lake to Lakeview, and the third from Bonners Ferry to Summit and then to Eastport, Idaho.

TRANSMISSION.

EUGENE, ORE.—Bids will be received up to January 11 for constructing a 2400-horsepower plant on the McKenzie River for pumping water from the river to Eugene.

GRANGEVILLE, IDA.—Ben Davis has purchased the White Bird Electric Company and will improve it by adding new machinery. The plant is operated by water power.

KENNEWICK, WASH.—The Columbia Basin Light & Power Company has asked permission of the Council to erect a high voltage transmission line from its plant to Washington Street and thence to Garden Tracts.

SANDPOINT, IDA.—The Humbird Lumber Company has announced plans for the construction next year of two power plants in connection with the company's Sandpoint and Kootenai mills, and a pumping plant at Kootenai.

SEATTLE, WASH.—A decision has been handed down by the Superior Court that the Pacific Coast Power Company, which is engaged in building a large power plant on White River, has a right to condemn lands along the river by showing that the waters of the stream are to be devoted to public use.

SAN ANDREAS, CAL.—Frank Z. Towle has filed claim to 30,000 inches of water of the south fork of the Mokelumne River, to be diverted below the junction of South and Lioking Forks; also a claim to 20,000 inches of water of the middle fork of the Mokelumne River, to be diverted on the land of James Porteous.

OROVILLE, CAL.—For the first time electric power was turned into the cables of the Great Western Power Company from the company's plant at Big Bend, the Berkeley hills being lighted through the transmission of the power. Sixty-three thousand horsepower was put upon the cables to test their efficiency, the test proving entirely satisfactory. The company's lines have been completed as far as the Bay.

EUREKA, CAL.—The Snow Mountain Power Company has ordered a 4,000-h. p. horizontal turbine for 450-foot head at 450 r. p. m. direct connected to a three-phase 60-cycle, 2,300-volt A. C. generator; also a 150-h.p. exciter set to be driven by a horizontal impulse wheel. This equipment is to be furnished by the Allis-Chalmers Company. F. G. Baum of San Francisco is consulting engineer for the power company.

REDDING, CAL.—The fourth power plant of the Northern California Power Company was started up last week for the first time, adding 3,000 horsepower to the system and making a total of 13,000 horsepower. The new plant is near Volta, where the company has two other plants. A fourth plant of this company is at Kilare, Shasta County. A fifth plant is now under construction on South Battle Creek, where 5,500 horsepower will be developed. The company intends to erect a sixth plant in the vicinity of the fifth, with a development of 8,500 horsepower.

RENO, NEV.—As the result of extremely cold weather, an ice gorge formed last week blocking the Truckee River at a point above Floriston and the power companies supplying electric power to Carson, Reno and the mines of Virginia City, had hard times keeping their lines open. The Butters plant, one of the largest in Virginia City, was compelled to close down, while Carson City was without light and power. An auxiliary plant in this city was all that kept Reno in light and power.

ILLUMINATION.

MADERA, CAL.—William N. Parker is seeking a franchise for the installation of gas works in this city.

AZTEC, NEW MEXICO.—An electric light franchise has been granted by the City Trustees to the Eden Canal, Land & Power Company.

PASADENA, CAL.—The City Council has awarded the contract for the supplying of 8,000 arc-light carbons, to the National Carbon Company.

ENTERPRISE, NEW MEXICO.—The Board of Trustees is considering the installation of a street lighting system, none having been decided upon as yet.

SIERRA MADRE, CAL.—The Board of Trustees of this place has called an election for February 24th, for the purpose of voting on the construction of a municipal gas plant.

POINT ARENA, CAL.—Application has been made to the Town Trustees of this place by C. E. Boyd, manager of the oil well here, for a franchise to install an electric light plant.

OAKLAND, CAL.—The Seventh Street Improvement Club has accepted the bid of the United Iron Works for the erection of 150 electroliers in Seventh Street, from Broadway to Bay Street in East Oakland.

SAN DIEGO, CAL.—C Street, from Third to Sixth, and Fifth Street, from B to C, will be electric lighted in the near future, a petition of the property owners for the same having been granted by the City Council.

NEWPORT, CAL.—The bid of the Standard Iron Works, of SanDiego, for twenty-five iron lamp-posts and the same number of four-burner arc lights, has been accepted by the Board of Trustees. The bid was $987.50.

DAYTON, NEW MEXICO.—The Dayton Gas & Oil Company is having its well near here repacked and cased with fine threaded piping to prevent the escape of gas. The company intends to start work immediately in laying a main to the town and bringing gas in at once.

SAN FRANCISCO, CAL.—A design for the lamp standards to be placed on Market, Valencia, and Sutter Streets by the United Railroads, has been prepared by the architectural firm of D. H. Burnham & Co. The work of placing the posts in position will begin as soon as the castings can be made.

PORTLAND, ORE.—Local capital, with offices at 338 Chamber of Commerce, has purchased the St. John Gas, Light & Heat Co., and will proceed to sell seock for the purpose of putting up a plant. W. S. Dole & Co., Lumber Exchange, are the consulting engineers. A site has already been secured.

ABERDEEN, WASH.—Electric lighting for South Aberdeen and Cosmopolis has been decided upon by the Grays Harbor Railway & Light Company, according to the statement made by Manager Crary. This will involve the expenditure for cable, wiring and lights of a sum estimated between $10,000 and $15,000.

OGDEN, UTAH.—Announcement has been made through Salt Lake City persons that Henry L. Lee, who was here a few weeks ago investigating the outlook for a new gas plant, has made a very favorable report to the New York company which holds the franchise, for a new gas system in Ogden.

ONTARIO, CAL.—Sealed bids will be received by the Town Clerk of Ontario, California, up to February 2d, for a franchise granting the right to lay gas pipes and conduits for a period of fifty years through the public streets and thoroughfares of the town, for the purpose of carrying and distributing gas for light and heat.

TRANSPORTATION.

BOISE, IDA.—A site has been selected for a depot to be built by the Boise & Interurban Railroad Company at Eagle.

AYLMER, ORE.—It is announced that the Hull Electric Company expects to construct two miles of new track next year.

TACOMA, WASH.—A franchise was granted to the Pacific Traction Company to construct a street car line on Eighth Street.

VANCOUVER, B. C.—The British Columbia Electric Railway Company is in the market for car trucks for six equipments.

ELLENSBURG, WASH.—The petition of A. S. Randall for a franchise for an electric line from South Cle Elum to Cle Elum Lake will be heard on January 11th by the county commissioners.

SPOKANE, WASH.—The Okanogan Electric Railway expects to begin construction in the Spring upon a line from the junction of the Okanogan and Columbia Rivers north along the Okanogan to a point near the Canadian line.

VALLEJO, CAL.—Randall, Trowbridge & Company, Oakland, Cal., have applied to the City Trustees for a franchise covering the principal streets of Vallejo, with the intention of constructing and operating an electric railway system.

CENTRALIA, WASH.—W. J. Patterson and A. Welch, who are identified with the electric railway system at Vancouver, Wash., have been granted a franchise to build and operate an electric railway in Centralia.

TACOMA, WASH.—The Puget Sound Electric Railroad has petitioned the Commissioners for a franchise for a new line from Brookville to Puyallup. The petition states that the company will construct either single or double tracks, and that steps have already been taken to acquire a right-of-way.

PORTLAND, ORE.—Announcement is made that during 1909 the United Railways Company will construct fifty miles of additional track. During the past year, the company built twenty miles of track from Claremont to Glen Harbor, Linnton and Holbrook.

CLE ELUM, WASH.—Through Frank S. Farquhar the Cle Elum-Rosyln Electric Railway & Power Co. applied to the county commissioners for franchise giving them the right to use the county road between Cle Elum and Rosyln. The commissioners set January 11th, 1909, for hearing of the matter, when the franchise will undoubtedly be granted.

WALLA WALLA, WASH.—Propositions for the construction of the entire road from Dayton to the river now are occupying the attention of the Walla Walla & Columbia River Traction Company. All propositions for grading and laying of steel are receiving careful consideration, and the contract will be left within a few days for the building of the entire line.

LIVINGSTON, MONT.—Engineers representing the motor power department of the Northern Pacific Railroad have been in Livingston, Mont., working on a plan to use electricity in carrying trains over the mountains just west of the city. It is stated that the proposition is being investigated and that at an early day electric power is likely to be used in pulling both passenger and freight trains over the mountains. If the plan is adopted the company will construct a large power plant at some point on the Yellowstone River.